

AMENDMENTS TO THE CLAIMS

Please amend the claims as follows:

1. (Previously Presented) A cathode sputtering apparatus for forming a uniform thickness layer of a selected material on at least one surface of at least one substrate/workpiece in a multi-stage process comprising deposition of a plurality of sub-layers, comprising:

(a) a first group of spaced-apart cathode/target assemblies comprising annular-shaped magnetron magnet assemblies; and

(b) a transportation unit for transporting at least one substrate/workpiece past each cathode/target assembly of said first group of cathode/target assemblies for deposition of a first plurality of sub-layers on a first surface of said at least one substrate/workpiece; wherein:

(i) each cathode/target assembly of said first group of cathode/target assemblies comprises a sputtering surface oriented substantially parallel to said first surface of said at least one substrate/workpiece; and

(ii) said first group of cathode/target assemblies is adapted to provide sub-layers with different sputtered film thickness profiles, such that said first plurality of sub-layers collectively form said uniform thickness layer of said selected material,

wherein the annular-shaped magnetron magnet assemblies have progressively increasing diameters, and

a distance between each sputtering surface and the at least one substrate/workpiece is progressively larger.

2. (Original) The apparatus as in claim 1, further comprising:

(c) a second group of spaced-apart cathode/target assemblies opposite said first group of spaced-apart cathode/target assemblies and adapted for forming a uniform thickness layer of said selected material on a second surface of said at least one substrate/workpiece in a multi-stage process comprising deposition of a second plurality of sub-layers, wherein:

(i) each cathode/target assembly of said second group of cathode/target assemblies comprises a sputtering surface oriented substantially parallel to said second surface of said at least one substrate/workpiece;

(ii) said second group of cathode/target assemblies is adapted to provide sub-layers with different sputtered film thickness profiles, such that said second plurality of sub-layers collectively form said uniform thickness layer of said selected material on said second surface of said at least one substrate/workpiece; and

(iii) said means for transporting said at least one substrate/workpiece past each cathode/target assembly of said first group of cathode/target assemblies further comprises means for transporting said at least one substrate/workpiece past each cathode/target assembly of said second group of cathode/target assemblies for deposition of said second plurality of sub-layers on said second surface of said at least one substrate/workpiece.

3. (Original) The apparatus as in claim 2, wherein:

the cathode/target assemblies of said first and second groups of cathode/target assemblies are in substantial vertical registry.

4. (Original) The apparatus as in claim 2, wherein:

the cathode/target assemblies of said first and second groups of cathode/target assemblies are located in a single vacuum chamber.

5. (Cancelled)

6. (Original) The apparatus as in claim 2, wherein:

the cathode/target assemblies of said first and second groups of cathode/target assemblies are located in a plurality of vacuum chambers.

7. (Original) The apparatus as in claim 6, wherein:

said plurality of vacuum chambers form an in-line or a circularly-shaped arrangement of chambers.

8. (Cancelled)

9. (Cancelled)

10. (Cancelled)

11. (Original) The apparatus as in claim 2, wherein:
said means for transporting said at least one substrate/workpiece past said first and second groups of cathode/target assemblies for deposition of said first and second pluralities of sub-layers comprises means for mounting and transporting at least one disk-shaped substrate/workpiece.

12. (Original) The apparatus as in claim 2, further comprising:
(d) shield means in spaced adjacency to the periphery of the sputtering surface of each cathode/target assembly.

13. (Currently Amended) A method of forming a uniform thickness layer of a selected material on at least one surface of at least one substrate/workpiece by means of a multi-stage process comprising sputter deposition of a plurality of sub-layers, comprising steps of:

(a) providing a multi-stage cathode sputtering apparatus comprising a first group of spaced-apart cathode/target assemblies comprising annular-shaped magnetron magnet assemblies and a transportation unit for transporting at least one substrate/workpiece past each cathode/target assembly of said first group of cathode/target assemblies, each cathode/target assembly comprising a sputtering surface oriented substantially parallel to said first surface of said at least one substrate/workpiece during transport of said at least one substrate/workpiece past said first group of cathode/target assemblies, said first group of cathode/target assemblies adapted for providing different sputtered film thickness profiles; and

(b) transporting said at least one substrate/workpiece past each cathode/target assembly while providing different sputtered film thickness profiles from at least some of said cathode/target assemblies, such that a first plurality of sub-layers is deposited on said first surface of said at least one substrate/workpiece which collectively form said uniform thickness layer of said selected material,

wherein step (a) further comprises a second group of spaced-apart cathode target assemblies, each comprising a sputtering surface oriented substantially parallel to a second surface of said at least one substrate/workpiece during transport of said at least one substrate/workpiece past each cathode/target assembly of said second group of cathode/target assemblies, said second group of cathode/target assemblies providing different sputtered film thickness profiles, and the sputtering surfaces of at least one cathode/target assembly of said first and second groups of cathode/target assemblies are located at a different spacing from the first and second surfaces of said at least one substrate/workpiece than another of the cathode/target assemblies; and

step (b) further comprises depositing a second plurality of sub-layers on said second surface of said at least one substrate/workpiece which collectively form said uniform thickness layer of said selected material, and

transporting at least one disk-shaped precursor substrate for a perpendicular magnetic recording medium past each annular-shaped cathode/target assembly of said first and second groups of cathode/target assemblies,

wherein each annular-shaped magnetron magnet assembly has at least one progressively increasing diameter and

a distance between each sputtering surface and the at least one substrate/workpiece is progressively larger.

14. (Cancelled)

15. (Previously presented) The method according to claim 13, wherein:
said first and second groups of spaced-apart cathode target assemblies are in substantial vertical registry; and

step (b) comprises substantially simultaneously forming said uniform thickness layer of said selected material on each of said first and second surfaces of said at least one substrate/workpiece.

16. (Previously presented) The method according to claim 13, wherein:
the cathode/target assemblies of said first and second groups of cathode/target assemblies form an in-line or circular-shaped arrangement in a single vacuum chamber.

17. (Previously presented) The method according to claim 13, wherein:
the cathode/target assemblies of said first and second groups of cathode/target assemblies are located in a plurality of vacuum chambers and said plurality of vacuum chambers form an in-line or circular-shaped arrangement.

18. (Cancelled)

19. (Cancelled)

20. (Previously presented) The method according to claim 13, wherein said means for transporting said at least one substrate/workpiece past each of said first and second groups of cathode/target assemblies comprises means for mounting and transporting at least one disk-shaped substrate/workpiece.

21. (Previously presented) The method according to claim 13, wherein the multi-stage cathode sputtering apparatus further comprises shield means spaced adjacent the periphery of the sputtering surface of each cathode/target assembly.

22. (Cancelled)

23. (Previously Presented) The method according to claim 13, wherein:
step (b) comprises forming an about 500 to about 4,000 Å thick layer of a magnetically soft underlayer (SUL), the SUL is selected from the group consisting of: Ni, NiFe (Permalloy), Co, CoZr, CoZrCr, CoZrNb, CoFeZrNb, CoFe, Fe, FeN, FeSiAl, FeSiAlN, FeCoB, or FeCoC on said first and second surfaces of said at least one precursor substrate.

24. (Previously Presented) A cathode sputtering apparatus for forming a uniform thickness layer of a selected material on at least one surface of at least one substrate/workpiece, comprising:

a group of spaced-apart deposition stations having a first group of annularly-shaped magnetron magnet assemblies, each annularly-shaped magnetron magnet assembly having at least one diameter corresponding to a thickness profile for depositing the selected material and a sputtering surface arranged substantially parallel to the at least one substrate/workpiece; and

a transportation unit for transporting the at least one substrate/workpiece past each deposition station,

wherein the thickness profile for each annularly-shaped magnetron magnet assembly is different,

the selected material is sequentially deposited as sub-layers having different thicknesses corresponding to the different thickness profiles, [[and]]

the deposition of the sub-layers result in the uniform thickness layer on the at least one substrate/workpiece, and

a distance between each sputtering surface and the at least one substrate/workpiece is progressively larger.

25. (Previously Presented) The apparatus as in claim 24, further comprising:

a second group of annularly-shaped magnetron magnet assemblies opposite the first group of annularly-shaped magnetron magnet assemblies for forming a uniform thickness layer of the selected material on a second surface of the at least one substrate/workpiece; and

a transportation unit for transporting the at least one substrate/workpiece past each cathode/target assembly of the second group of annularly-shaped magnetron magnet assemblies for deposition of the sub-layers on the second surface of the at least one substrate/workpiece,

wherein each cathode/target assembly of the second group of annularly-shaped magnetron magnet assemblies comprises a sputtering surface oriented substantially parallel to the second surface of the at least one substrate/workpiece, and

the second group of annularly-shaped magnetron magnet assemblies provides sub-layers with different sputtered film thickness profiles, such that the sub-layers collectively form the

uniform thickness layer of the selected material on the second surface of the at least one substrate/workpiece.

26. (Cancelled)

27. (Previously Presented) The apparatus as in claim 1, wherein the at least one diameter of each annular-shaped magnetron magnet assembly is an inner diameter.

28. (Previously Presented) The apparatus as in claim 1, wherein the at least one diameter of each annular-shaped magnetron magnet assembly is an outer diameter.

29. (Previously Presented) The method according to claim 13, wherein the at least one diameter of each annular-shaped magnetron magnet assembly is an inner diameter.

30. (Previously Presented) The method according to claim 13, wherein the at least one diameter of each annular-shaped magnetron magnet assembly is an outer diameter.

31. (Previously Presented) The apparatus as in claim 24, wherein the at least one diameter of each annularly-shaped magnetron magnet assembly is an inner diameter.

32. (Previously Presented) The apparatus as in claim 24, wherein the at least one diameter of each annularly-shaped magnetron magnet assembly is an outer diameter.